

CLAIMS

What is claimed is:

1. A fuel cell power plant (60) for generating electrical current from reducing fluid fuel and oxygen containing oxidant reactant streams, comprising:

- 5 a. at least one fuel cell (10, 62) having an electrolyte (12) secured between an anode catalyst (14) and a cathode catalyst (16), a wetproofed anode support means (20) secured in direct fluid communication with the anode catalyst (14) for passing the fuel reactant stream adjacent the anode catalyst (14), and a cathode support means (24) secured in direct fluid communication with the cathode catalyst (16) for passing the oxidant reactant stream adjacent the cathode catalyst (16);
- 10 b. a porous anode cooler plate (26) defining a plurality of fuel channels (28A, 28B, 28C, 28D) on a first surface (30) and a plurality of coolant channels (32A, 32B, 32C, 32D) on an opposed second surface (34) of the cooler plate (26), the plate being secured adjacent the anode support means (20) so that the fuel channels (28A, 28B, 28C, 28D) are adjacent the anode support means (20);
- 15 c. a direct antifreeze solution passing through the coolant channels (32A, 32B, 32C, 32D) for cooling the fuel cell (10);
- 20 d. a separator plate (36) secured adjacent the coolant channels (32A, 32B, 32C, 32D) of the anode cooler plate (26) for prohibiting movement of the direct antifreeze solution through the separator plate (36);
- 25 e. a porous cathode water management plate (38)

defining a plurality of oxidant channels (40A, 40B, 40C, 40D) on a first surface (42) and a plurality of water management channels (44A, 44B, 44C, 44D) on an opposed second surface (46) of the water management plate (38), the water management plate (38) being secured adjacent the cathode support means (24) so that the oxidant channels (40A, 40B, 40C, 40D) are adjacent the cathode support means (24) and so that fuel cell (10) water flows through the cathode support means (24) and into and through pores and the water management channels (44A, 44B, 44C, 44D) of the plate (38), the water management channels (44A, 44B, 44C, 44D) being in fluid communication with a fuel cell water discharge (126) for discharging water out of the fuel cell (10); and,

50 f. pressure control means for maintaining a positive pressure differential between the fuel stream passing through the fuel channels (28A, 28B, 28C, 28D) and the direct antifreeze solution passing through the coolant channels (32A, 32B, 32C, 32D) of the anode cooler plate, and between the oxidant stream passing through the oxidant channels (40A, 40B, 40C, 40D) and the product water passing through the pores of the water management plate (38).

2. The fuel cell power plant (60) of claim 1, further comprising a coolant loop (102) through which the direct antifreeze solution circulates, including a coolant outlet line (88) that directs the direct antifreeze solution from the coolant channels (32A, 32B, 32C, 32D) through a coolant pump (90), a coolant evaporator (92), a radiator (96) to remove

10 heat from the direct antifreeze solution, and through a coolant feed line (86) back into the coolant channels (32A, 32B, 32C, 32D) of the anode cooler plate (26).

3. The fuel cell power plant (60) of claim 2 further comprising an oxidant recycle line (118) secured in fluid communication between an oxidant discharge line (114) that discharges oxidant from the oxidant channels (40A, 40B, 40C, 40D) and the coolant evaporator (92) for directing heated oxidant from the fuel cell (62) to the evaporator (92) to assist in evaporating water from the direct antifreeze solution.
4. The fuel cell power plant (60) of claim 1, wherein at least one water management channel (108) is defined within the cathode water management plate (104) to extend between a condensation zone (132) adjacent an oxidant discharge line (114) and an evaporation zone (134) adjacent an oxidant feed line (112) to direct flow of water from the condensation zone (132) to the evaporation zone (134).
5. The fuel cell power plant (60) of claim 1, further comprising a cooler plate peripheral edge seal (48A, 48B) secured between a peripheral edge of the second surface (34') of the anode cooler plate (26') and the separator plate (36'), a solid edge seal (50A, 50B) secured between the separator plate (36') and the anode support means (20') and overlying a peripheral edge of the anode cooler plate (26'), and an anode support peripheral edge seal (52A, 52B) to prohibit movement of the direct antifreeze solution through the peripheral edge of the anode cooler

plate (26') or through the peripheral edge of the anode support means (20').

6. The fuel cell power plant (60) of claim 1, further comprising a plurality of the at least one fuel cells (10, 62) cooperatively disposed to form a fuel cell stack assembly and having a separator plate (36, 71) secured adjacent the coolant channels (32A, 32B, 32C, 32D, 70) of the anode cooler plate (26, 66) of each fuel cell (10, 62) and secured between each adjacent fuel cell (10, 62) of the cell stack assembly.
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7. The fuel cell power plant (60) of claim 1, wherein the cathode support means (24) is selected from the group consisting of a wetproofed cathode support means and a non-wetproofed cathode support means.